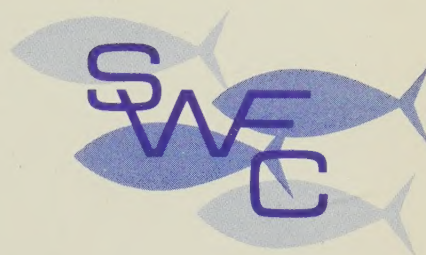


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SOUTHWEST FISHERIES CENTER

MONTHLY REPORT - JULY 1981

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SOUTHWEST FISHERIES CENTER

LA JOLLA, CALIFORNIA

HONOLULU LABORATORY

LA JOLLA LABORATORY

TIBURON LABORATORY

PACIFIC ENVIRONMENTAL GROUP

MONTHLY REPORT - JULY 1981

STATUS OF PUBLICATIONS

Published

Gooding, Reginald M., William H. Neill, and Andrew E. Dizon. 1981.
Respiration rates and low-oxygen tolerance limits in skipjack tuna,
Katsuwonus pelamis. Fish. Bull., U.S. 79(1):31-48.

Oxygen-uptake rates and swimming speeds of voluntarily active skipjack tuna, Katsuwonus pelamis, at 23°-24°C were measured in the laboratory from captivity-habituated fish (0.6-3.8 kg) and at sea from just-caught fish (1.8-2.2 kg). In the shipboard tests, skipjack tuna swam 2-5 lengths/s (length = fork length) and consumed 0.9-2.5 (median = 1.3) mg O₂/g per h during their first 2.2 h of captivity. In laboratory tests, skipjack tuna swam at a mean speed of 1.4 lengths/s and consumed oxygen at a mean rate of 0.52 mg O₂/g per h. For the laboratory fish, routine swimming speed (S, in lengths/second) was inversely related to fish weight (W, in grams)-- $S = 3.12 - 0.53 \log_{10} W$; oxygen-uptake rate (V_{O₂} in milligrams O₂/gram per hour) was directly related to both weight and speed (i.e., speed independent of weight effects)-- $\log_{10} V_{O_2} = -1.20 + 0.19/\log_{10} W + 0.21 S$. However, laboratory fish swimming at their characteristic (weight dependent) speeds respired at rates independent of weight. Calculations based on the above interrelations among metabolic rate, swimming speed, and body weight indicated that skipjack tuna of all sizes may have an optimum swimming speed (for maximum distance per unit energy expenditure) near 2.1 lengths/s.

Captivity-habituated skipjack tuna (0.8-3.4 kg) also were subjected to a step decrease in concentration of dissolved oxygen (O₂) at 23°-24°C to determine their responses to acute hypoxia. At levels of O₂ below 4 mg/l, voluntary swimming speed increased

as O_2 declined, reaching 3.9 lengths/s at the lowest test value of O_2 , 1.4 mg/l. The 4-h median limit for log O_2 proved similar to the O_2 level critical for change in swimming speed, about 4 mg/l.

Experimental results are analyzed and compared with those from other fishes to arrive at the following conclusions: 1) The skipjack tuna's "standard" metabolic rate is two to five times that of typical fishes of similar size; 2) the weight exponent for "standard" metabolic rate of skipjack tuna is a positive value near 0.2, as opposed to the -0.2 value typical of fishes; 3) but, because the characteristic swimming speed of routinely active skipjack tuna is inversely related to weight, routine metabolic rate is virtually independent of fish weight; 4) highly active skipjack tuna can consume oxygen from air-saturated seawater at rates exceeding those known from any other fish of similar size; and 5) the skipjack tuna is relatively inefficient in its use of oxygen and food-energy for swimming (at least at low speeds) and it dies at O_2 levels still well above those lethal for other fishes.

Hobson, E.S., W.N. McFarland, and J.R. Chess. 1981. Crepuscular and nocturnal activities of Californian nearshore fishes, with consideration of their scoptic visual pigments and the photic environment. Fish. Bull., U.S. 79:1-30.

This paper defines certain basic patterns of activity in Californian coastal fishes that differ from comparable patterns in tropical fishes, and relates these differences to lesser predation pressures. The paper nevertheless documents strong predation pressures on the Californian species by citing certain features of their scoptic (dim-light sensitive) visual pigments. The spectral sensitivities of these pigments cluster around 500 nm, which is best for vision during twilight and for sensing bioluminescence at night in Californian coastal waters. On the other hand, this position is poorly matched to moonlight and starlight--the major sources of incident light at night. Probably the fishes benefit from this arrangement mostly on defense. The match with twilight may enhance vision during the crepuscular periods of intensified threats from predators, and the match with bioluminescence may permit reaction to threatening moves of predators by responding to luminescing plankton that fire in the turbulence generated by these moves.

Kaya, Calvin M., Andrew E. Dizon, and Sharon D. Hendrix. 1981. Induced spawning of a tuna, Euthynnus affinis. Fish. Bull., U.S. 79(1):185-187.

Perrin, W.F., and A.C. Myrick, Jr. (editors). 1981. Age Determination of Toothed Whales and Sirenians. Proceedings of the International Conference on Determining Age of Odontocete Cetaceans [and Sirenians], September 5-19, 1978, La Jolla, California. Rep. Int. Whal. Commn. (Special Issue 3).

The following papers were published in Perrin and Myrick (1981):

Domnig, Daryl P., and Albert C. Myrick, Jr. Tetracycline marking and the possible layering rate of bone in an Amazonian manatee (Trichechus inunguis), pp. 203-207.

This paper reports the first successful use of tetracycline marking of layered bone in a manatee and suggests that this technique may be useful in estimating age for species of this family. A 6 month old male Amazonian manatee (Trichechus inunguis) was first injected with Terramycin on 23 August 1976 (2.2 mg/kg) and subsequently on 18 and 19 November 1977 (7.1 and 8.5 mg/kg, respectively). After the animal died, on 3 May 1978, a transverse thin section of one of its ribs was examined microscopically using plain and polarized transmitted light and ultraviolet reflected light. One fluorescent mark, probably representing the 1977 injections, was found in the periosteal bone between the first and second of three layers containing aligned Haversian systems. It is likely that, for this species, 2.2 mg/kg dosages are insufficient to mark bone, but dosages between 7.1 and 8.5 mg/kg are adequate. An average accumulation rate of one layer per year is suggested by our analysis of this specimen.

Hohn, Aleta, A. Analysis of growth layers in the teeth of Tursiops truncatus using light microscopy, microradiography, and SEM, pp. 150-160.

Preliminary results show microradiography and scanning electron microscopy (SEM) to be more accurate methods of accessing growth layer groups (GLG) in the teeth of Tursiops truncatus than transmitted light microscopy. Microradiography shows the rhythmic deposition of mineral as alternating radiopaque and radiolucent layers. It improves the resolution of GLGs near the pulp cavity in older individuals, better than either SEM or light microscopy. SEM of etched sections show GLGs as ridges and grooves which are easily counted from the micrograph. SEM also shows GLGs to be composed of fine incremental layers of uniform size and number which may allow for more precise age determination. Accessory layers are usually hypomineralized layers within the hypermineralized layer of the GLG and are more readily distinguishable as such in SEM of etched sections and microradiographs than in thin sections viewed under transmitted light. The neonatal line is hypomineralized, appearing translucent under transmitted light, radiolucent in a microradiograph, and as a ridge in SEM.

Kimura, Makoto. Variability in techniques of counting dentinal growth layer groups in a tooth of a known-age dolphin, Tursiops truncatus, pp. 161-163.

A photograph of a mid-longitudinal tooth section of a known-age

bottlenose dolphin was used to evaluate the techniques of six experienced tooth readers in counting the growth layer groups (GLGs).

The results point up the problem of using different criteria to define GLGs. When age is known, GLG counts may be similar even if somewhat different landmarks in the tissue are used. However, when age is unknown, GLG definitions tend to be more variable among readers using different criteria. The results of the present exercise suggest a critical need to intercalibrate the various aging techniques for given species.

Myrick, Albert C., Jr. Examination of layered tissues of odontocetes for age determination using polarized light microscopy, pp. 105-112.

The polarized light microscope with a $1/4 \lambda$ plate greatly improves resolution of the microstructure in layered hard tissues of dolphins by revealing changes in crystallographic alignment not visible using more conventional instruments. In adult specimens of Stenella attenuata the prenatal enamel contains up to 240 striae that are thought to represent daily records of prenatal growth. Prenatal dentine contains approximately 60 incremental layers, the significance of which is unknown at present. In Lagenorhynchus, Delphinus, Tursiops, and Stenella spp. the neonatal "line" consists of several incremental layers, suggesting that post-parturitional trauma may be a prolonged event. In these species the postnatal dentine contains 13 regularly-spaced accessory layers in the first five or six growth layers (GLGs). These accessory layers are thought to reflect lunar cycles, and each contains an average of 28 microlayers (lines of von Ebner) that may represent daily growth increments. Cemental GLGs show fewer accessory layers than those of dentine. GLGs in periosteal bone consist of accessory layers that may reflect lunar cyclicity. It is suspected that layering in dentinal, cemental, and periosteal tissues is in response to the same cyclic influences.

Myrick, Albert C., Jr. Some approaches to calibration of age in odontocetes using layered hard tissues, pp. 95-97.

Current methods in determining age of odontocetes rely upon untested assumptions. The relationship between layering and absolute age requires calibration. To achieve this goal, five approaches are suggested: (1) the establishment of a reference collection for known-age, minimum known-age, and time-marked samples; (2) the construction of developmental series of layered hard tissues representing individuals from various taxonomic and geographical stocks; (3) the tagging and recovery of wild animals that have been time-marked; (4) an extended program of multiple time-marking and extraction of teeth of live-captive animals; and (5) the study of layered hard tissues in conjunction with clinical records of specimens treated with fluorescent antibiotics. Pilot programs using these approaches are in various stages of

implementation at the Southwest Fisheries Center, La Jolla.

Scheffer, Victor B. and Albert C. Myrick, Jr. A review of studies to 1970 of growth layers in the teeth of marine mammals, pp. 51-63.

This is a review of the discoveries of layers in teeth of marine mammals and subsequent researches that led to the widespread use of dental layers for age determination of marine mammals. Zoologists during the 19th century noted the existence of layers in marine mammal teeth, but it remained for Boschma, in 1938, to associate dental layers with age, and Chapskii, in 1941, to recognize the value of layers to wildlife research. Methods for aging and analyzing samples from marine mammal populations were developed in the early 1950s and have since been applied to most extant species of toothed marine mammals. A systematic account of the first 40 years of age determination research on 36 species of Cetacea, Pinnipedia, and Sirenia, is presented.

Zweifel, J.R. and W.F. Perrin. Fitting growth curves to odontocete tooth layer/length data, page 216 [abstract only].

Attempts in the past to fit single continuous curves to length/age data for odontocetes have not been successful. Length/age scatter-plots for sperm whales, ziphiids and delphinids show a discontinuity at puberty. A similar pattern exists in the primates. For lower mammals, Gompertz-type growth curves fit the data well. Application of a two-phase Gompertz model to delphinid data produces better fits than previous models tried, and this approach has promise for analysis of growth of other odontocetes.

Uchiyama, James H., and Paul Struhsaker. 1981. Age and growth of skipjack tuna, Katsuwonus pelamis, and yellowfin tuna, Thunnus albacares, as indicated by daily growth increments of sagittae. Fish. Bull., U.S. 79(1): 151-162.

Counts of the daily growth increments on otoliths provided the means for establishing growth curves for central Pacific skipjack tuna, Katsuwonus pelamis, up to 3 years old and for central Pacific yellowfin tuna, Thunnus albacares, up to 2 years old. The data indicated three stanzas of linear growth for 51 skipjack tuna ranging in size from 3 to 80 cm fork length. Estimated daily growth rates were 1.6 mm/day for fish up to a length of about 27.0 cm; 0.8 mm/day for fish between 27.0 and 71.4 cm; and 0.3 mm/day for fish between 71.4 and 80.3 cm. Growth data for eastern Pacific skipjack tuna ranging in size from 38 to 65 cm fork length suggested that skipjack tuna in the eastern Pacific grew at a slower rate than those from the central Pacific.

Age determinations of 14 central Pacific yellowfin tuna suggested possibly two stanzas of linear growth. Estimated growth rates are 1.4 mm/day for fish up to a length of 64.2 cm and 0.9 mm/day for fish between 64.2 and 93.0 cm. Growth curves from this study were compared with published growth curves based on other methods.

The validity of daily growth increments was tentatively determined by observations on skipjack and yellowfin tunas held in captivity. Agreement of our growth curves with those of previous studies on the same stock of tunas using other growth estimating techniques also suggests that our aging technique is acceptable. However, the day-to-growth increment relation and the effect of various variables on the formation of growth increments of tunas need to be investigated further.

Webb, P.W. and R.T. Corolla. 1981. Burst swimming performance of northern anchovy, Engraulis mordax, larvae. Fishery Bulletin, U.S. 79(1): 143-150.

Burst swimming performance was measured for northern anchovy larvae from 0.23 to 1.33 cm total length at a temperature of 17°C. Fast starts and burst swimming were initiated using a 3 V/cm direct current electric shock. Performance was measured from movie film recorded at 250 frames/s. Percentages of larvae responding to the stimulus increased from 9% 40 hours after eggs were spawned to a maximum 95 + 4% after 125 hours. Distances traveled in a given time period increased linearly with length so that maximum speed (U_{max}) and mean speed ($\bar{U}$) similarly increased linearly with total length (L) according to $U_{max} = 20.8 L + 1.95$; $\bar{U} = 8.18 L + 4.89$. The maximum distance traveled per burst (S_{max}) was used as a measure of endurance and increased with length according to $S_{max} = 3.79 L + 0.08$. These swimming speeds and endurance relationships can explain a large portion of size-dependent selectivity of towed plankton nets.

Technical Memorandum

Goldberg, Stephen R., and Hillary Herring-Dyal. 1981. Histological gonad analyses of late summer-early winter collections of bigeye tuna, Thunnus obesus, and yellowfin tuna, Thunnus albacares, from the northwest Atlantic and the Gulf of Mexico. NOAA-TM-NMFS-SWFC-14.

Approved by Center Director

DeMaster, Douglas P. Density-dependence as a special case of resource-dependence. For consideration of publication in Marine Mammal Information.

Administrative Reports

Honolulu Laboratory

- Adams, Michael F. 1981. Competition and market structure in the Hawaii fishery industry. SWFC Admin. Rep. No. H-81-5.
- Shippen, Nathaniel T. 1981. Seamount fishery, foreign vessel observer report, Aso Maru (June 6-19, 1981). SWFC Admin. Rep. No. H-81-4.

La Jolla Laboratory

- Huppert, D., R. Klingbeil, J. McMillan, and R. Read. 1981. California's northern anchovy fishery for 1980/1981. SWFC Admin. Rep. LJ-81-16.
- Stauffer, G.D., and R.L. Charter. 1981. The northern anchovy spawning biomass for the 1981-82 California fishing season. SWFC Admin. Rep. LJ-81-17.

HONOLULU LABORATORY

Honolulu Laboratory Scientists Moderate Fishery Technical Sessions

Honolulu Laboratory Director Richard S. Shomura, Dr. Michael Adams, Industry Economist, and Dr. Jerry Wetherall, Leader of the Pelagic Stock Assessment Study Task, served as moderators of fisheries technical sessions at the joint annual conference of the Western Association of Fish and Wildlife Agencies and the Western Division, American Fisheries Society, held in Honolulu, Hawaii, July 12-16, 1981.

Shomura moderated the session on "Tuna Biology and Management," a panel discussion which included Dr. Izadore Barrett, Director of the Southwest Fisheries Center; Harold Cary of the United States Tuna Foundation, San Diego; Dr. Andrew Dizon of the SWFC's Honolulu Laboratory; Dr. James Joseph of the Inter-American Tropical Tuna Commission, La Jolla; Dr. Robert Kearney of the South Pacific Commission, Noumea, New Caledonia; and Dr. George Kent, Professor of Political Science at the University of Hawaii.

Speakers participating in the session moderated by Dr. Wetherall were Peter Fithian of the Hawaiian International Billfish Tournament, Honolulu, Hawaii; Svein Fougner of the Western Pacific Regional Fishery Management Council, Honolulu, Hawaii; and Dr. Richard Brill and Dr. Richard Radtke of the Pacific Gamefish Foundation, Honolulu, Hawaii.

Speakers in the fishery economic sessions moderated by Dr. Adams included Dr. L.J. Bledsoe from the University of Washington, Seattle, Washington; Dr. James Wilen of the University of California, Davis, California; Dr. Adams; and Vidar Westested and Joe Terry of the Northwest and Alaska Fisheries Center, NMFS, Seattle, Washington.

INSULAR RESOURCES INVESTIGATION

TOWNSEND CROMWELL Departs on Final Tripartite Cruise

Richard N. Uchida, Leader of the Insular Ecosystem Study, reports that the NOAA Ship Townsend Cromwell departed Snug Harbor, Honolulu, on July 17, 1981 to begin cruise TC-81-04 in the waters of the Northwestern Hawaiian Islands (NWHI). This cruise is the last in a series of NWHI survey and assessment cruises that first began in October 1976 under the Tripartite Cooperative Agreement with the U.S. Fish and Wildlife Service and the State of Hawaii's Department of Land and Natural Resources (the University of Hawaii's Sea Grant Program at a later date became a participating agency in the investigation of the living terrestrial and marine resources of the NWHI).

The missions of this final cruise are (1) to survey the Hawaiian monk seal (Monachus schauinslandi) and green turtle (Chelonia mydas) at Pearl and Hermes Reef, French Frigate Shoals, Laysan, Lisianski, Necker, and Nihoa Banks; (2) to assess the resources of spiny lobster (Panulirus marginatus), shrimp (Penaeus sp. and Heterocarpus spp.), kona crab (Ranina ranina), deep-sea bottom fish of the snapper-grouper complex, and benthopelagic fishes such as bigeye scad (Trachurops crumenophthalmus) and mackerel scad (Decapterus spp.); and (3) to conduct experiments on (a) the predation on surface-released sublegal and berried lobsters, (b) methods of releasing lobsters to maximize survival, and (c) the response of lobsters to the carcasses and offal of other lobsters.

Personnel in the scientific field party include Chief Scientist Reginald M. Gooding, Wildlife Biologists William G. Gilmartin, John R. Henderson, and George H. Balazs, and Research Assistants Anne M. Houtman, Steven H. Kramer, Michael P. Seki, James L. Prescott, and Gordon W. Tribble. David Macauley of the U.S. Fish and Wildlife Service will also be aboard the Cromwell during the early part of the cruise. He will disembark at Nihoa to assist Dr. Sheila Conant of the University of Hawaii with ongoing studies of land and seabirds nesting on that island.

Preparation of Northwestern Hawaiian Islands Fishery Atlas Underway

This month Fishery Biologist James H. Uchiyama began coordinating the work of several investigators who will jointly prepare a manuscript, "Fishery Atlas of the Northwestern Hawaiian Islands." Uchiyama worked with Research Assistant Darryl T. Tagami to obtain computer listings of (1) all species caught during the NWHI survey cruises, (2) all species caught by island or bank, (3) all species caught by type of gear, and (4) all species caught segregated by depth of capture.

Work Progresses on Insular Ecosystem Study Task Data Bases

Research Assistant Darryl T. Tagami worked this month on a data base, file-naming convention for data collected by the Insular Ecosystem Study Task. He and Computer Aid Brent M. Miyamoto also edited the Task's Trap, Pot, and Net Report and completed writing the criteria for editing data on the Daily Catch Report--Handline Fishing tape files.

Tagami also worked with Richard N. Uchida, Study Leader, and Computer Aid Karen P. Wendel to prepare summaries of trawl catches, species composition, and size frequency distribution of the trawl catches at Hancock and other seamounts in the vicinity of Midway Islands, in preparation for a groundfish workshop scheduled in November 1981.

Spawning and Fecundity of Snappers Studied

Research Assistant Alan R. Everson continued work on the spawning and fecundity of snappers caught in the NWHI. Preliminary results indicate that

the peak spawning period for kalikali (Pristipomoides sieboldi) and ehu (Etelis marshi) extends from late July to late September.

* * * * *

Richard N. Uchida, Task Leader, this month continued work on the fisheries section of a Guam/Northern Marianas background document. Fishery Biologist Paul M. Shiota also continued work on a manuscript which he is preparing in collaboration with Uchida, which deals with the status of several Hawaiian fisheries. Fishery Biologist James H. Uchiyama began work on a paper which will be presented at an otolith workshop to be held in Florida during February 1982.

* * * * *

Paul M. Shiota, Fishery Biologist, has prepared a list of gear and equipment needs for the Resource Assessment Investigation of the Mariana Archipelago (RAIOMA) survey cruises scheduled in 1982, and, at the request of the Director's Office, has prepared a summary of porpoise sightings on cruises of the Cromwell to the NWHI.

FISHERY MANAGEMENT PROGRAM

New Procedure Devised to Estimate Statewide Hawaii Skipjack Tuna Landings

Because it was believed that the old procedure underestimated the actual figures, Gary L. Kamer, Statistician, has devised a new procedure to estimate the monthly statewide landings of skipjack tuna in Hawaii. Instead of using the total landings at Hawaiian Tuna Packers (HTP) to estimate total State landings, the total landings at the HTP made by vessels belonging to the Tuna Boat Owners' Co-op, Inc. (TBOCI) are used. A regression relating the total State landings as reported by the Hawaii Division of Aquatic Resources (HDAR) to the landings of TBOCI vessels was computed using data from 1964 to 1979 for this purpose. The regression describing the relationship is:

$$\text{HDAR} = 1.4121(\text{TBOCI}) + 133,880(\text{S})$$

where HDAR is the estimated statewide landings in pounds, TBOCI is the total landings in pounds of vessels belonging to TBOCI and S is 1 for June through September and 0 for the rest of the year.

The new procedure gave higher estimates of the statewide landings of skipjack tuna than that given by the old procedure (Table 1).

Table 1.--Estiamted statewide skipjack tuna landings.

Month	Old (MT)	New (MT)
January	36.4	37.7
February	33.4	37.1
March	71.3	98.1
April	128.7	170.2
May	188.9	212.1
June	--	382.1

Hawaii Skipjack Tuna Landings
Continue Below Long-Term Average

The July 1981 Hawaii landings of skipjack tuna were estimated at 523 metric tons (MT), which is 155 MT above the July 1980 landings and 219 MT below the 1964-79 long-term average for July. The cumulative landings from January through July were estimated at 1,446 MT, which is 596 MT above the 1980 landings for the same period and 1,066 MT below the 1964-79 long-term average for the same period (Figure 1).

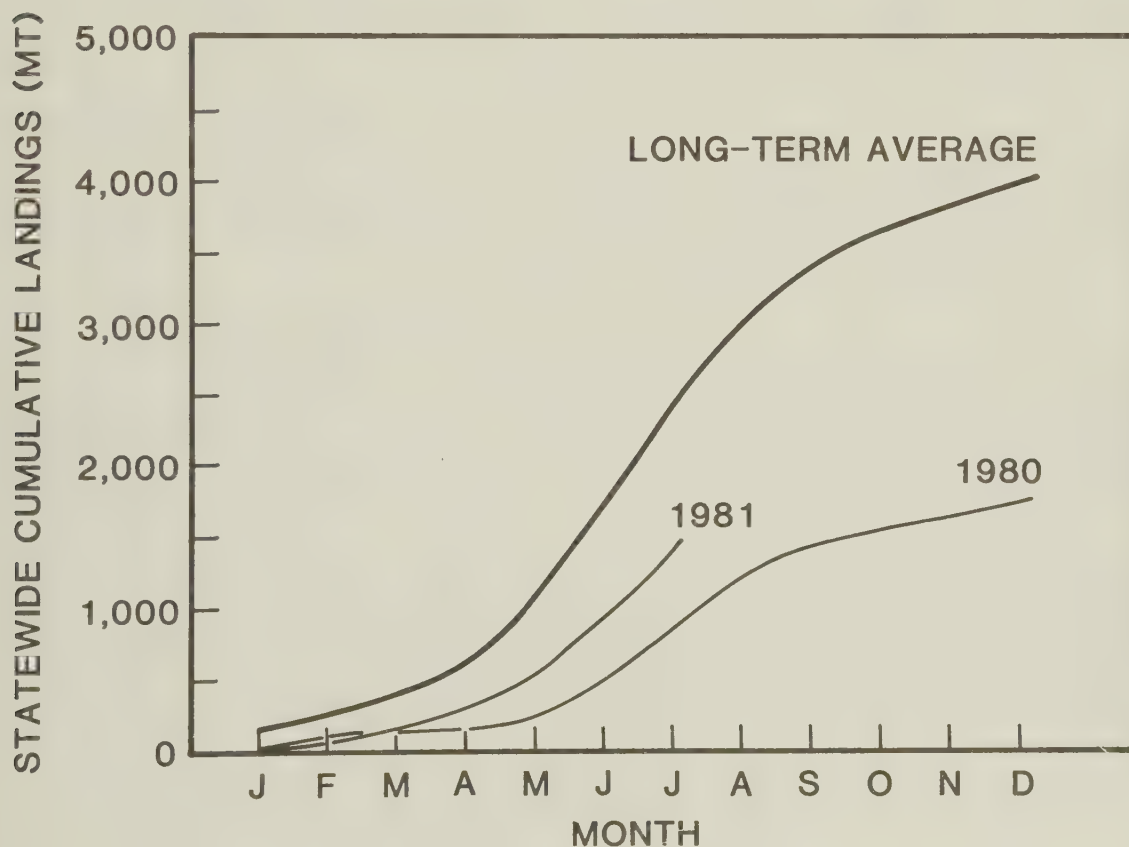


Figure 1. Cumulative landings in the Hawaiian skipjack tuna fishery.

* * * * *

David C. Hamm, Computer Systems Analyst, has joined the Honolulu Laboratory staff to administer the Laboratory's Fishery Information Network (FIN) project. Several meetings have been held with personnel of the HDAR and the contractors for the collection of historical fisheries data from American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands (CNMI), to monitor the progress of the existing contracts and to plan for FY 1982 activities.

PELAGIC RESOURCES INVESTIGATION

Additional Seabird Diet Summaries Prepared

Thomas S. Hida, Fishery Biologist, reports that additional data summaries have been completed for his study of the food habits of seabirds based on spew samples. The goatfish, family Mullidae, ranked as the most important prey of the black noddy Anous tenuirostris; followed by the lizardfish, family Synodontidae; sprats, family Clupeidae; and flyingfishes, family Exocoetidae. The prey ranged from 5 to 167 mm and averaged 34.3 mm.

The most important prey of the blue-gray noddy, Procelsterna cerulea, was the water strider, Halobates sericeus (family Gerridae), followed by unidentified juvenile fishes, flyingfishes, lizardfishes, and goatfishes. The calanoid copepod, Pontella atlantica (family Pontellidae), was also a common prey item. The prey items of the blue-gray noddy tern were generally very small: 2 to 50 mm with an average of 9.3 mm.

The cowfish, Lactoria fornasini (family Ostraciidae), ranked highest in the diet of the gray-backed tern, Sterna lunata. Other important prey were flyingfishes, goatfishes, water striders, man-of-war fish, Nomeus gronovii (family Nomeidae), and the juveniles of the two species of dolphin, Coryphaena hippurus, and C. equiselis (family Coryphaenidae). The prey items were 3 to 138 mm long and averaged 19.6mm.

The goatfish was the most important prey item of the brown noddy, Anous stolidus, followed by squids mostly in the family Ommastrephidae. Other important prey items were the lizardfish and jacks, family Carangidae, mostly Decapterus sp. Most of the fish prey items were juveniles. The size of the prey ranged from 3 to 185 mm and averaged 48.2 mm.

LA JOLLA LABORATORY

Coastal Fisheries Resources Division

Northern Anchovy Use Chemical Cues to Locate Prey

Dr. Colin Barnett, NRC Postdoctoral Research Associate at the Southwest Fisheries Center, reports that he has demonstrated the ability of northern anchovy (*Engraulis mordax*) to detect and orient towards its prey using chemical cues alone. The results of this research will help provide explanation for anchovy foraging success at sea.

The experimental design utilized a circular pool 15 ft. in diameter. PVC panels were placed upright in the pool, intersecting at its center (Figure 1) and dividing the pool into four quadrants (Figure 2). Two outlets were placed at the corner of each quadrant: one just below the surface of the water in the pool and one just above the bottom of the pool; these provided each quadrant with a constant flow (0.7 liters per minute) of sand-filtered, UV-treated sea water. During a test, this constant flow was replaced by four identical Nalgene plastic bottles delivering water at equal rates (0.7 liters per minute) and temperature (ambient sea temperature) to each of the four quadrants. One bottle contained the test chemical and sea water; the other three bottles contained sea water only.

Test substances included washes and extracts of important food items in the anchovy diet (see Table I). Washes were defined as water in which the prey had been living for 24 hours. Extracts were homogenates of prey items and sea water. All test substances were filtered through a 10 μ m Nitex filter, thus removing particulate matter from the water. Washes and extracts were frozen in glass containers until needed.

Tests were conducted twice a day (during the light phase of the anchovy photoperiod), six days a week. At the end of each week the anchovy were fed one-half pound (wet weight) frozen brine shrimp, the pool was vacuumed, and a sufficient number of anchovy was added to replace the ones which had died during the week (usually 3 or 4), thus maintaining the school size at one hundred individuals (92.0 mm mean standard length; 7.3 g mean weight).

Each week a different substance was tested. Each consecutive test utilized a solution which was half the concentration of the solution used in the preceeding test, until no response was obtained (as visually judged by an observer concealed behind a blind). This "no-response" test was repeated: each subsequent test utilized a solution that was twice as concentrated as the solution used in the preceeding test, until 12 tests had been performed that week. A typical sequence would be as shown on page 16:

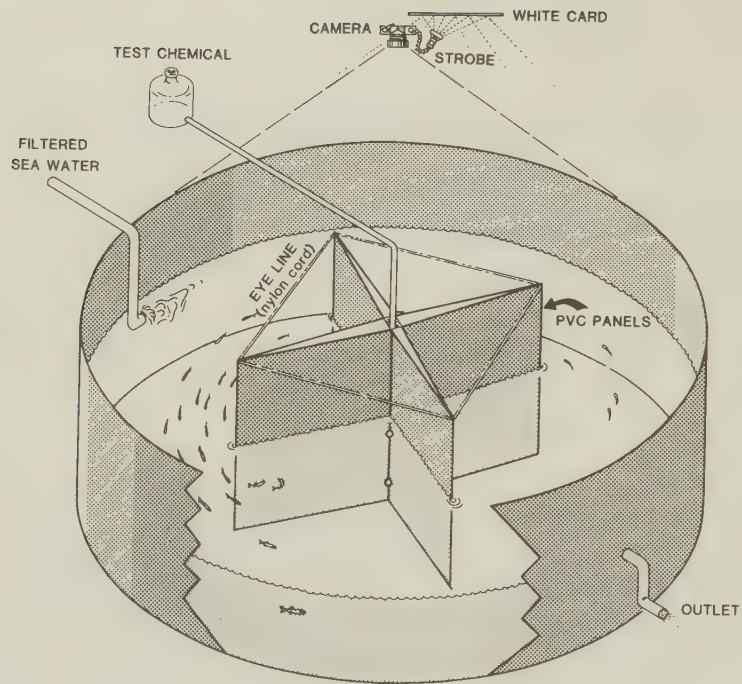


Fig. 1. The test apparatus. Only one of the four bottles is shown.

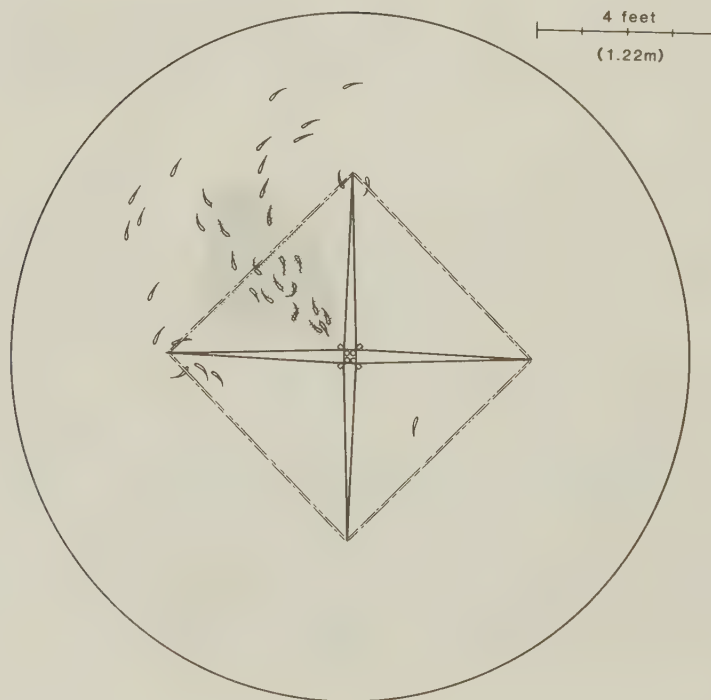


Fig. 2. Representative topography of a test chemical diffusing from the corner of a quadrant.

Table I. Chemosensory thresholds of food items for the northern anchovy. These thresholds represent the smallest concentration at which the anchovy showed any detectable response, as inferred qualitatively from visual inspection of photographs. Quantitative analysis may yield revised estimates of chemosensory thresholds.

Substance	Threshold ¹	
	Grams dry weight of organisms/liter	Organisms/liter ²
1. Copepods (<u>Tigriopus</u> sp.)(.2mm) ³		
a. wash	6.03×10^{-2}	1.15×10^4
b. extract	8.21×10^{-5}	1.57×10^1
2. Shrimp (<u>Artemia salina</u>)(5mm) ⁴		
a. wash	1.11×10^{-1}	1.88×10^2
b. extract	4.25×10^{-4}	7.19×10^{-1}
c. frozen	5.91×10^{-4}	1.00×10^0
3. Euphausiid (<u>Euphausia pacifica</u>)(8mm)		
a. frozen	3.74×10^{-3}	4.27×10^{-1}
4. Eggs of northern anchovy (<u>Engraulis mordax</u>)(1mm)		
a. wash	3.01×10^{-2}	1.00×10^3
b. extract	3.86×10^{-5}	1.28×10^0
5. Green algae (<u>Gymnodinium splendens</u>)(43 m)		
a. wash	1.92×10^{-1}	1.64×10^7
b. (extract)	7.84×10^{-2}	6.70×10^3

¹These thresholds are an upper boundary. Preliminary analysis of the dilution of the substance as it enters the tank suggests that the anchovy are probably responding to thresholds 10^{-2} times less concentrated than the tabulated values.

²Calculated by grams dry weight per liter/grams dry weight per organism.

³Calanoid copepods are a dominant food item for the anchovy but were difficult to obtain in pure cultures. Tigriopus (not a part of the anchovy diet) was substituted as a copepod food item because it was readily available in culture.

⁴Brine shrimp (Artemia) are not consumed by anchovy in the wild. They are used here as a standard, easily obtainable, test substance. The fact that the anchovy used as subjects in these experiments were fed entirely on brine shrimp may contribute to their sensitivity to brine shrimp as a test substance.

⁵Sea water in which a frozen block of the organisms had been thawed. Since crustaceans are likely to suffer physical damage during freezing, these "washes" may more likely be extracts. Compare 2b and 2c.

⁶No live euphausiids were obtainable.

⁷Anchovy did not respond to this. No higher concentration was available. Lower concentrations yielded no response. The highest concentration tested is considerably higher by several orders of magnitude than the density of the organisms in the field.

⁸The dominant green algae in the anchovy gut is Chaetocerus sp. However, Gymnodinium is also a food item for the anchovy and was readily available in large cultured quantities for the tests.

⁹This substance contained 1.18×10^7 Gymnodinium cells per liter. Thus the threshold indicated is a response threshold rather than a chemosensory one. The next lower concentration (50 per cent less) produced no response. I was able to obtain 4 liters of Gymnodinium extract free of cells (7.84×10^{-2} grams dry weight/liter, equivalent to 6.70×10^0 cells per liter). Even though this extract had a very strong odor to the human nose, the anchovy showed no response to it.

DAY:	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday	
TEST:	1	2	3	4	5	6	7	8	9	10		
CONC.												
OF TEST												
SOL'N:	X	X/2	X/4	X/8	X/16	X/32*	X/64#	X/64	X/32	X/16	X/8	X/4

*Nominal threshold.

#No response.

The concentration of solution used in the test proceeding the "no-response" test is nominally termed the threshold concentration, although the true threshold lies below that concentration because the test substance is immediately diluted upon entering the tank.

Beginning with the introduction of the test substance into the tank, 34 overhead photographs were taken at 15-sec intervals using a photographic strobe. These photographs were used to analyze the behavioral response of the anchovy to each test situation. In a typical test using a high concentration of test substance, the anchovy first swim slowly around the periphery of the tank: very few are in the quadrants (Figure 3). After several minutes, several individuals are observed to enter the test quadrant into which the test substance is flowing. The fish make rapid circling motions, often breaking the surface of the water (Figure 4). This searching behavior indicates that the anchovy have detected the test substance.



Fig. 3. Anchovy in a normal swimming mode; no test substance in the water.



Fig. 4. Early sign of anchovy detecting the substance--breaking the water surface and circling. Upper left quadrant.

These initial anchovy may move out of the test quadrant and rejoin the school. Eventually, however, more and more anchovy enter the test quadrant, each one displaying marked searching behavior. A maximum response is considered to have occurred when a large majority (often about 95 per cent) of the school enters the test quadrant (Figure 5). During the duration of the test (about 9 minutes), individual anchovy may leave the test quadrant and even visit other quadrants, but two observations always hold true: 1) the mean number of anchovy in the test quadrant during the 34 exposures is markedly higher than in any other quadrant, and 2) the searching behavior is performed only in the test quadrant.



Fig. 5. Full response to an odor. In this case, brine shrimp extract.

A maximum feeding response, consisting of synchronized, elliptical swimming by the school and frequent filtering by school members, was never seen at any concentration. It appears that while chemical food cues alone are sufficient to induce a breakdown in school formation and to elicit food searching, actual food particles are required to produce a complete feeding response. [It is not known to what aspects of the food particles are required to produce a complete feeding response.] It is not known to what aspects of the food particles the anchovy respond. Both taste and tactile cues are available.

By plotting the location of the fish in each of the 34 photographs taken during a test, one can determine the latency of first response, the number of fish responding in each photograph, the position of fish with respect to the odor gradient, and other quantitative measures of chemosensory detection. As

of this writing, very few of the photographs have been so analysed. However, all the photographs have been qualitatively inspected to determine the concentration of test substances at which the anchovy showed any response at all. The lowest such concentrations can be used as preliminary estimates of threshold concentrations (see Table I).

Anchovy were able to detect the three crustacean prey species by chemical cues alone. The washes, and especially the extracts of euphausiids, brine shrimp, and copepods, reliably produced strong and rapid responses such as those illustrated in Figure 5. Crustacean extracts were about three orders of magnitude more detectable than washes. The anchovy's ability to chemically detect Gymnodinium or anchovy egg wash is questionable. At best, such substances appeared to slightly disrupt normal swimming, but the effect was weak and difficult to interpret. In contrast, anchovy responded well to anchovy egg extract (Table I, 4b). The evaluation and verification of such results must await quantitative analysis of the photographs. When this has been done, the chemosensory thresholds can be used to conduct a model of anchovy foraging on these food items at sea.

This model will assume that these food items occur in discrete patches which anchovy encounter by semi-random movement in the ocean. The larger the patch size, the more likely an anchovy school is to encounter it. If anchovy are able to detect a chemical cloud around the patch, then the patch size has effectively been increased. To estimate this increased patch size, one must know the volume of the plankton patch, the excretion rate of the plankton, and the chemosensory thresholds of the anchovy. Data on plankton patch volumes exist in the reports of the Food Chain Research Group at Scripps Institution of Oceanography and the CalCOFI reports. The patch excretion rate, which will vary with patch density, can be represented as 20 to 30 percent of the feeding rate.

Given the excretion rate, patch radius, and a diffusion coefficient, the concentration of the planktonic chemical products can be estimated at various distances from the center of the patch (ignoring turbulent diffusion). A hypothetical surface may then be drawn through all points at which the concentration equals the wash threshold determined in these experiments. The volume enclosed by this surface is the effective patch size available to foraging anchovy.

Dr. Barnett's NRC Research Associateship terminated on July 31, 1981. He has accepted an Alexander von Humboldt Fellowship at the University of Bielefeld, West Germany, where he will study chemoreception in cichlid fish in the laboratory of Dr. Klaus Immelmann. Alex Iacopozzi, a laboratory assistant at the Southwest Fisheries Center, made major contributions to the research described in this report.

LARVAL FISHES, COASTAL EAST PACIFIC PROGRAM

Program Leader Visits Instituto del Mar del Peru

Under the German-Peruvian Program, Dr. John Hunter, Fishery Biologist and Leader of the Larval Fishes, Coastal East Pacific Program, visited the Instituto del Mar del Peru (IMARPE), Callao, Peru, from June 9-July 2. He presented 8 lectures and held many informal discussions with the scientists involved in basic biological research on the Peruvian anchoveta. The objectives of Hunter's visit were to provide technical assistance on the egg production biomass estimate technique and to provide advice on the various projects in the basic biology program. He was asked by both Peruvian and German scientists to provide an informal report on his recommendations regarding existing programs and future research. Copies of this 15-page report are on file at the Southwest Fisheries Center.

Larval Fish Rearing Experiments Conducted in Denmark

Fishery Biologist Gail Theilacker has returned from Copenhagen, Denmark, where she worked for 2 months with a fishery research team headed by Dr. Jan Beyer at the Danish Institute for Fishery and Marine Research, Charlottenlund Slot. While there Theilacker instructed researchers on larval fish rearing techniques and collaborated on a series of rearing experiments using larval herring. The investigation included a study of growth and mortality, feeding rates, prey selection, and evacuation rates. In all experiments, the larval herring were fed low densities of wild plankton.

Starvation-induced mortality was also investigated using herring larvae, and an attempt was made to characterize larval condition on a weight-length basis. Theilacker had previously studied starvation metabolism on larval northern anchovy. The results from her earlier study showed that starving anchovy larvae conserved their length while losing weight. Using these results, Beyer and Theilacker established a working hypothesis: During starvation of herring larvae, standard length does not decrease until the time when activity decreases and the larvae are unable to eat. Assuming this hypothesis is true, then larval condition can be expressed as a length-weight relationship in terms of current body weight relative to maximum body weight obtained in the past. Theilacker designed a series of experiments to determine the minimum body weight a starving larva can attain and still maintain its ability to feed.

All starvation experiments were conducted with wild plankton-fed larvae of known age and uniform size. Herring larvae were sized using a microscope prior to transferring them to the test tank. Test larvae were starved for a certain period of time, then fed on successive days. The larval size, individual weight, and incidence of feeding were recorded on each sampling day, and some larvae from both feeding categories were sampled for histology. This experiment was repeated using larvae at four different ages: first-feeding larvae at age 3 days, age 11 days, 17 days, and 24 days. The larvae

sampled from the first-feeding experiment have been weighed, and the results are shown in Table 1.

Table 1. Percentage body weight lost at sampling compared to average body weight of population at start of experiment (using 8 mm Danish herring).

Age	Days starved	Initial # larvae	# dead larvae	# eating	Eating % weight loss	# not eating	Not eating % weight loss	% not eating
4	1	31	3	23	19.0	3	29.5	12
6	3	50	9	30	24.5	11	29.4	26
8	5	50	14	9	31.0	27	39.3	75
9	6	50	15	3	27.9	31	41.2	91
10	7	100	59	6	32.9	30	37.5	83

Theilacker and Beyer's preliminary conclusions from this experiment with first-feeding herring larvae are that 1) the decrease in larval length during starvation is less than 1% until the point of no feeding is reached; 2) length decrease after point of no feeding is between 5-10%; and 3) the point of no feeding occurs when about a 30% drop in body weight is observed.

COMMERICAL AND RECREATIONAL FISHERIES FOR MANAGEMENT PROGRAM

1981-82 Anchovy Optimum Yield Presented at Meetings

This month Dr. Gary Stauffer, Fishery Biologist, presented the 1981 estimate of the anchovy spawning biomass to a joint meeting of the Pacific Fishery Management Council and California Fish and Game Commission in Long Beach, and to the PFM Council in Boise, Idaho. The Council recommended that the Southwest Regional Office of the National Marine Fisheries Service accept the 1981 larva census estimate of 2,803,000 short tons which gives a U.S. optimum yield of 420,700. The Commission has not taken any action on the matter yet.

At both meetings the anchovy discussion was dominated by the merits and hazards of the joint venture proposed by Marine Resources Company to purchase jack mackerel, Pacific mackerel, squid, and anchovies from the San Pedro purse seine fleet. The Council recommended that NMFS grant the joint venture for 15,000 tons jack mackerel, 18% incidental catch of Pacific mackerel, 2,500 tons squid and 10,000 tons of anchovies. The Southwest Region is reviewing the optimum yield, domestic annual harvest, and domestic annual processing for the various species. Seiners participating in the joint venture will require special permits from the California Fish and Game Commission. The Commission has not yet considered the permit requests.

Anchovy Biomass Estimation Reviewed

Susan Picquelle, Statistician, continued to study the review by Dr. Donald McCaughran of the International Halibut Commission, of the anchovy biomass estimate based upon the egg production method. Picquelle outlined McCaughran's main comments and will modify the Stauffer and Picquelle manuscript on the 1980 egg production estimate where appropriate.

McCaughran proposed two models for estimating daily egg production. One model assumes that all spawning during a 24 hour period occurs at one instance in time; the other model assumes that spawning occurs at a constant rate over a specified time period within the daily cycle. Both models assume exponential mortality and constant continuous sampling. Picquelle expanded McCaughran's explanation of the models to include the derivations of the formulas and checked his assumptions and equations. Picquelle and Dr. Gary Stauffer, Fishery Biologist, then applied these models to the 1980 CalVET survey data set. The resulting estimates of egg production and mortality were virtually identical to the values produced by the model used for the 1980 biomass estimate. Because McCaughran's models are more logical and clear cut, they will be adopted for the estimation method for 1981.

Work Continues on Egg and Anchovy Samples

Dr. Gary Stauffer, Fishery Biologist, reports that the processing of the CalVET egg samples and the adult anchovy trawl samples is progressing about on schedule. The team of plankton sorters at Scripps Institution of Oceanography has completed the CalVET samples from the first egg survey, 8102 cruise, and about half of the samples from the second survey, 8104 cruise. The larva identification group under the supervision of Dr. Geoff Moser, Fishery Biologist, has completed the egg staging for 3/4 of the 8102 samples. Under the direction of Dr. John Hunter, Fishery Biologist, Scott Miller completed the first stage of dissecting and cataloging ovaries from the formalin-preserved female anchovies taken aboard the two California Fish and Game Nelle Belle sonar trawl surveys and the chartered seiner Mary Louise. He is presently working up the fecundity samples for the second Nelle Belle cruise. Processing the frozen samples for estimating sex ratio is about 25% completed. The histological examination for staging the condition of the female ovaries will be completed for the first Nelle Belle cruise in early August.

ARMS Database Update Almost Complete

Susan Iacometti, Computer Programmer, reports that the editing, verification, and updating of the Aerial Marine Resource Monitoring System (AMRMS) database through 1979 is almost completed. The computer programs for editing and verifying the data were modified to account for the addition of several new pilots and their planes. Up to now, the programs have been stored on cards. Consequently, some parts were lost or misplaced and had to be redone as part of this ongoing project. During the cleaning-up stages of the updating process, the working programs will be stored on tape and the manual

will be updated to reflect the differences, including execution instructions. The coding of this database, thanks to Amy Kimball, NOAA Junior Fellow working at the lab through the summer, is caught up almost to the end of 1980. The conversion of the database onto the VAX for use with DATATRIEVE has been halted until the updating processes are completed.

Manuscript Prepared on Economic Research Needs for Living Marine Resources

Dr. Daniel Huppert, Supervisory Industry Economist, has completed a manuscript on economic research needs for living marine resources to be presented to the workshop on Ocean Resources Economics, September 13-16, 1981. Emphasizing fishery economics and research issues, Huppert provides support for additional research in three areas: (1) theoretical development of models with multi-species resources, of cost and production functions for multi-product, multi-input fishing firms, and of optimal adaptive harvest strategies with uncertain biological and economic conditions; (2) analysis of trade policies for fishery products and U.S. foreign fishing regulations; and (3) development of domestic fishery management institutions that meet bioeconomic conservation criteria and operational benefit-cost tests.

Analysis of Partyboat Data Resumed

Dr. Daniel Huppert, Industry Economist, and Jane McMillan, Economist, have resumed their econometric investigation of recreational participation functions based upon the 1979-80 partyboat survey data. Participation is explained in two stages: first, the decision of whether to participate is to be modeled using a discrete choice, conditional logit method; and second, the frequency of participation (i.e., number of fishing trips taken per year) is being estimated as a standard weighted regression problem. The second step is essentially complete, while the first step will require the adoption of a maximum likelihood estimation program on the VAX computer.

Market Squid Stock Assessed

The Pacific Fishery Management Council (PFMC) recently voted to allow joint-venture harvesting of several pelagic species off California. One of these species is the market squid, *Loligo opalescens*. Federal law requires a management plan for fisheries involving foreign participation. In anticipation of developing a preliminary management plan to govern the harvest of market squid, a quick stock assessment was produced. This study is based on analyses and information compiled by the squid plan development team of the PFMC. However, the draft squid plan lacked a documented estimate of squid abundance.

A tentative estimate of squid biomass was produced using a California Fish and Game study of Pacific bonito (*Sarda chiliensis*) food habits conducted in 1968-69. The ratio of squid to anchovy, by volume, in bonito stomachs was 0.24. The 1969 CalCOFI survey produced an anchovy spawning biomass estimate

of 2.72 million metric tons. Under the assumption that bonito stomach contents reflect the proportion of squid to anchovy in the ocean, the squid biomass is 0.24 of the anchovy biomass, or 65,000 metric tons. While this estimate certainly is open to question, it agrees with independent "educated guesses" made by experts.

MULTISPECIES TAXONOMY PROGRAM

Anchovy Eggs, Larvae Studied and Staged

Dr. Geoff Moser, Fishery Biologist and Program Leader, reports that the first part of July was spent completing an anchovy egg and yolk sac larva incubation experiment in cooperation with Fishery Biologist Carol Kimbrell. Eggs were incubated at three temperatures (13.5, 15.0, 16.5°C) and sampled hourly until hatching. Thereafter, the yolk sac larvae were sampled and measured every 4 hours until yolk depletion. The eggs were staged to establish the relation between age and stage at each temperature, and eye pigmentation of the yolk sac larvae was examined to determine the usefulness of the late David Kramer's eye pigmentation stages of classification.

Anchovy eggs from the CalVET samples were also staged for the 1981 spawning biomass estimate. Cruise 8102, consisting of 670 samples, was completed during the month. Other fish eggs and larvae present in the vertical nets were identified. Cruise 8104 with 460 samples will be completed in August. The final cruise from the 1978 CalCOFI survey was also completed during the month. Identification of fish eggs and larvae from cruise 7808 was finished and data from all other 1978 cruises are being entered into a computer as time becomes available.

Maria Perez, an Upward Bound student, performed an excellent job curating the ichthyoplankton samples in the reference collection, under the supervision of Biological Technician Betsy Stevens. Stevens also supervised Imogene Coe, a volunteer student from England, in reorganizing and curating the fish egg and larva reference collection.

Oceanic Fisheries Resources Division

MARINE MAMMAL BIOLOGY AND TECHNOLOGY PROGRAM

Report Completed on Stranded Marine Mammals Recovered by SWFC, 1966-80

John R. Henderson, Fishery Biologist, has completed a draft of a report entitled, "Stranded marine mammals recovered by SWFC, 1966-1980." The report

discussed the history of research on marine mammal strandings that have occurred in San Diego County from 1966 to the present, including the beginning of the Cooperative Marine Mammal Salvage Program (CMMSP) in 1979. The CMMSP currently responds to all marine mammal strandings (cetacean and pinniped). The primary participants in the CMMSP are the Southwest Fisheries Center, the Naval Ocean Systems Center, and the Hubbs-Sea World Research Institute.

A single central telephone line has been established (714-234-1991) to receive calls, and is staffed 24 hours a day. To date, 127 cetaceans and 19 pinnipeds have been recovered and 20 of these have had necropsies. In Henderson's report, the cetacean strandings are broken down by species, location, and date.

Coastal Marine Mammal Project Staff Applies for Permits to Tag California Sea Lions

An application to permit the tagging of up to 1,000 pups, 500 adult females, 50 subadults, and 50 adult males has been submitted to the Permits and Documentation Division of NMFS by the SWFC's Coastal Marine Mammal Project. The tagging (considered a "take" in the terminology of the Marine Mammal Protection Act of 1972) will take place on San Nicolas, San Miguel, Santa Barbara, and San Clemente Islands over a 3-year period. The anticipated results of the tagging project include estimates of pup survival, estimates of survival from age 0 to the age of first breeding, estimates of the adult reproductive rate, and estimates of site fidelity. In addition, studies on marked adults during the breeding season will enhance understanding of behavioral characteristics that may respond to changes in density. The permit application was published in the Federal Register, and the period for comment ended on July 21, 1981.

Joint Study on Pinniped Feeding Ecology Initiated at San Miguel Island

Dr. Douglas DeMaster, Project Leader of the Coastal Marine Mammal Project, is participating in a cooperative research project on pinniped feeding ecology at San Miguel Island off the California Coast. The study was put together by Robert DeLong of the Northwest and Alaska Fisheries Center (NWAFC), as part of a larger program on pinniped research at San Miguel Island. G. Kooyman of the Scripps Institution of Oceanography, who has pioneered the development of self-contained depth-of-dive recorders for pinnipeds, participated in the field work and supplied the recorders. The field work, scheduled to take place between 21 July and 8 August 1981, was designed to outfit both California sea lions and northern fur seals with the depth-of-dive recorders. The research is intended to provide information on the duration of feeding cycles in these two species, as well as feeding depth. Radio transmitters will also be attached to the test animals, to facilitate their recapture.

SWFC Cooperates with NWAFC on Fur Seal Research

Larry Hansen, Biological Technician, was stationed on San Miguel Island for 6 weeks beginning 8 June 1981, to learn techniques for studying pinnipeds and to assist NWAFC personnel in research involving the northern fur seal (Callorhinus ursinus). He participated in the census, capture, marking, and tagging of northern fur seals and also became familiar with fur seal behavior in a breeding colony. Hansen has recently been assigned to the Coastal Marine Mammal Project, where he will participate in censusing and tagging of California sea lions and northern elephant seals. His new assignment also includes assisting in the collection of stranded marine mammals under the Cooperative Marine Mammal Salvage Program.

Analysis of "Sundown Sets" Completed

James M. Coe, Fishery Biologist, and Charles W. Oliver, Computer Specialist, have completed analysis of the effects of curtailing the setting of tuna purse seine nets on dolphins during the late afternoon. These analyses were started during January 1981 at the request of the NMFS Southwest Regional Office. Current regulations on such sets are not being enforced pending completion of review of the data and analyses. Early results showed a much higher average mortality for sets made on dolphins within 90 minutes of sundown than for sets made at other times of the day.

Computer analysis was started in April, following the completion of a common data base incorporating data from NMFS, the Inter-American Tropical Tuna Commission (IATTC), and industry sources. The results of these analyses have now been incorporated into a draft manuscript, with review to begin in early August.

SWFC Assists with Installation of Dolphin Safety Equipment

Biological Technician Mark Lowry traveled to Panama July 19-26 to oversee the installation of dolphin safety panels and super aprons for the tuna purse seiners, Marjorie R and Sandra C. He was also able to mark the stern tie-down point for each vessel for backdown, using the empirical tie-down formula recently developed by SWFC gear experts. This formula greatly increases the accuracy of aligning the super-apron system on vessels that are unable to perform a trial alignment set.

Paper Completed on Age Determination of Florida Manatees

Dr. Al Myrick, Wildlife Biologist, reports that the first draft of a paper describing the development and application of methods to determine age of Florida manatees has been completed and is being sent out to a number of sirenologists for review. The paper is the result of work conducted recently by Myrick and Jeffrey S. Kelly, intern student from Southampton College, New York.

The study showed that age may be determined accurately by growth layer counts from decalcified and stained thin sections of the periotic bone and cheek teeth. The layers are associated with time based on studies of teeth from a captive manatee that received tetracycline injections over a period of time. Tetracycline is incorporated with the teeth soon after its administration, so the tetracycline mark on the teeth was used as a reference time mark. Annual, lunar-monthly, daily and half-day layers were detected in manatee hard tissues. Formation, eruption and shedding rates of cheek teeth were also determined.

Special Issue on Age-Determination Published

The volume resulting from the conference and workshop on age determination of toothed cetaceans and sirenians held at SWFC in 1978 has been published. Drs. William Perrin and Al C. Myrick, Jr., of the SWFC's La Jolla Laboratory, are editors of the book. The volume "Age determination in toothed whales and sirenians" (W.F. Perrin and A.C. Myrick, Jr., eds.), Rept. Int. Whaling Comm. Special Issue No. 3 (1980), may be ordered from the International Whaling Commission for approximately \$37.00 (depending on exchange rate). It contains papers by several members of the SWFC research staff (see Status of Publications section, this issue).

Efforts Underway to Wrap up Dolphin Tagging Tracking Project

Jacqueline Jennings, Fishery Biologist, reports that she and Raymond Stives, Fishery Technician, are concluding several research activities concerned with the tagging and tracking of dolphins. Jennings has been working with R. White of the Hubbs-Sea World Research Institute (HSWRI) to complete a Technical Memorandum on their tagging, freeze branding, and tattooing research. She also met this month with Dr. Christopher Stevens of the Jet Propulsion Laboratory to discuss the possibility of their laboratory continuing development of satellite-linked animal transmitters. NASA has indicated a willingness to consider supporting user agencies with research and development efforts of this type.

Jennings and Stives have been preparing a final distribution of posters soliciting reports of sightings of dolphins tagged in 1978. Several sighting reports of tagged dolphins in the southwest Pacific have been received from the boating community.

Jennings is also overseeing the contractor's evaluation of the satellite transmitter which was recovered during a field experiment in Hawaii in June (see June 1981 issue of the SWFC Monthly Report for experiment details), and Stives has written a manuscript describing the results of tests of various bimetallic corrosible nut and bolt combinations for timed-release of the satellite packs.

MARINE MAMMAL MONITORING AND ASSESSMENT PROGRAM

Aerial Photographs of Dolphin Schools Analyzed

Lt. Cdr. Wayne Perryman, NOAA Corps, reports that photographs of dolphin schools from the 1980 cooperative aerial survey conducted by the National Marine Fisheries Service (NMFS) and the Inter-American Tropical Tuna Commission (IATTC) have been screened locally and at the NASA facility in Bay St Louis, Mississippi, to select those of suitable quality for animal length measurements. The actual measurements are made on a comparator, which is an instrument designed to make very precise measurements from photographs. So far, measurements from one school have been reviewed and the results look very encouraging. Based upon these initial results, plans are being made to measure animals in the remaining schools, which consist of about 20,000 spinner dolphins.

Computer Programs for Porpoise Data Management System Updated

Dr. Tim Smith, Program Leader, reports that the preliminary design and documentation of the porpoise data management system software to be used on the VAX computer system have been completed. Coding of several programs to create, update, and modify VAX "data bases" has been started. One large group of subroutines, a "Fortran Database Formatting Package," emulates some of the program interface subroutines used on the old INFONET system. The structured testing and debugging of 1981 editing programs converted from INFONET to VAX has been completed. Computer edits of the 1981 data will next be completed. In addition, programs to edit historical data from 1971-1973 also have been completed. Life history data, International Whaling Commission data, and APL programs are not being transferred to the VAX. Remaining files that will be moved to the VAX have been identified and the jobs scheduled. All jobs should be completed by the end of July.

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As a result of the conversion to VAX, Computer Programmers Bruce Wahlen and Ken Wallace have designed a new VAX data structure for a "Trip Database" which is to be used in estimating porpoise mortalities. The design also includes a new method of estimating mortalities. Testing of the new structure has begun and will be completed in August.

TUNA/BILLFISH RESOURCES PROGRAM

Billfish Tagging Awards Presented

On July 8 Jim Squire, Fishery Biologist at the La Jolla Laboratory, presented the 1980 Gardiner Foundation Awards in a ceremony at Rancho Buena Vista S.A., Baja California Sur, Mexico. The Gardiner Awards are given annually to the Mexican sportfishing boat captains who tag and release the most billfish in a year. This year's award recipients were determined from billfish tag cards received by the SWFC in 1980. This year's first place winner was Captain Jesus Ariaza Ruiz, who has placed first in past years. Captain Ariaza, and the crewmen and anglers on his boat, tagged and released 135 billfish in 1980, an outstanding all-time tag and release record for an individual captain. The tagging total for the first six winners was 339 billfish, with only a difference of 5 fish separating the 3rd to 6th-place winners.

The awards, made possible by the Gardiner Foundation of Oakland, California, consist of an engraved plaque plus a cash award: 1st place, \$100; 2nd, \$80; 3rd \$60; and 4th through 6th, \$40. The Gardiner Foundation also presents a plaque award to the fishing resort which tags the most billfish. Hotel Rancho Buena Vista again was the winner, having won every year since the start of the award program.

Speakers at the annual ceremony included Herbert Kameon, Director of the National Coalition for Marine Conservation-Pacific Region and member of the NMFS Marine Advisory Committee; Mark Walters, owner of Rancho Buena Vista; and Dave Plowman, President of the Northern California Tag and Release Club.

Tagging Data for International Skipjack Year Computerized

Mathematician Al Coan and Fishery Biologist Ron Rinaldo report that they have placed all data collected during the 1980 International Skipjack Year (ISY) U.S. tagging cruise on a computer tape. The ISY tagging cruise was conducted in the Caribbean and western Atlantic from February 4 to April 18, 1980. The tagging effort was part of the International Skipjack Year Program. The primary purpose of the tagging project was to better understand the distributions, migrations and stock structures of Atlantic skipjack tuna. The area of investigation centered in the Caribbean Sea, including the Lesser Antilles, and southeast along the coast of South America to French Guiana. The tape contains data on tuna sightings and catches, baitfish captures, tag releases, cruise tracks, and environmental observations.

Fishery Management Plan for Billfish and Oceanic Shark Revised

A revised draft of the Billfish and Oceanic Shark Fishery Management Plan has been completed by the FMP development team. Team members include Industry Economist Dr. Sam Herrick, Fishery Biologists Jim Squire and Dr. Wes Parks of the SWFC, and Fred Hagerman of the California Department of Fish and Game. The draft is being typed and will be reviewed by the Team before distribution to the Advisory Panel for review; it will then be sent to the Pacific Fishery Management Council (PFMC) for consideration. The target date for submission to the PFMC is October 1981.

Status of Atlantic Tuna Fishery Sampling Programs

From January 1 to August 1, 1981, four U.S. tuna purse seiners fishing in the Atlantic Ocean unloaded in Puerto Rico. Seventeen size- composition samples were collected for the SWFC by Inter-American Tropical Tuna Commission personnel. The sampling distribution by species is as follows:

Sampled	Vessels sampled	# of samples	# of fish sampled
Yellowfin	4	6	300
Skipjack	4	12	600
Bigeye	2	3	43

Foreign-caught Atlantic tunas transshipped to Puerto Rico are sampled routinely for biological information by Biological Technician Eugene Holzapfel. Data on fork length, weight and species composition of catches are collected. Results of Holzapfel's sampling from January 1 to August 1, 1981 are as follows:

Species	Gear	No. of samples	No. of fish sampled	Tonnage sampled (MT)
Yellowfin	Baitboat	3	163	32.85
	Purse seine	5	249	370.14
Skipjack	Baitboat	1	50	63.29
	Purse seine	3	151	490.90
Bigeye	Baitboat	2	48	3.18

Swordfish Manuscript Completed

Fishery Biologist Earl Weber has submitted a manuscript entitled, "An analysis of the California swordfish harpoon fishery" to California Fish and Game. The manuscript describes the commercial and sport fisheries operating off the U.S. west coast with emphasis on an analysis based largely on logbook data collected from the commercial harpoon swordfish fleet.

TIBURON LABORATORY

FISHES COMMUNITIES INVESTIGATION

Pattern of Rockfish in King Salmon Diet Different in 1981

Fishery Biologist Peter Adams of the Predator-Prey Task is sampling king salmon as part of an attempt to identify the major sources of predation on rockfish species. It has been discovered that the pattern of shortbelly rockfish (*Sebastes jordani*) in the diet of king salmon is radically different in 1981 than in previous years. In 1980, shortbelly rockfish were found in the stomachs of king salmon taken from the south of Farallon Islands. This occurrence usually begins in mid-May and continues until late July. The smallest shortbelly rockfish was 18 mm (standard length); at this size, the fish is still in the larval stage. The largest fish in the stomach samples was 75 mm which is the end of the pelagic juvenile stage. There is a gradually increasing trend in the size of the fish during this period.

In 1981, shortbelly rockfish are still being found in king salmon stomachs from the same general area. However, the first occurrences were noted in late April; these fish were 29 mm and larger, and were pelagic juveniles.

Shortbelly rockfish appear to be much more important in the king salmon diet in 1981, both in numbers and volumes, than during previous years. However, they drop out of the diet in mid-June with a maximum size of 55 mm. The rockfish of 1981 also seem to be a larger size at any given time of the year, to be available earlier to the king salmon, and to be available in larger numbers. These factors suggest that the 1981 year class of shortbelly rockfish may be a strong one. It is not clear, but it appears that the early termination of feeding on shortbelly rockfish is not due to characteristics of this fish, but rather to the availability of other prey.

Sites Established for Long-term Measurements of Seasonal Change in Nearshore Communities

To measure seasonal patterns of occurrence of certain key members of the nearshore marine communities of northern California, Investigation Leader Dr. Edmund S. Hobson, along with Fishery Biologist Tony Chess and Biological Technician Dan Howard, this month established three locations for long-term study on the Mendocino Coast. Stakes were cemented into position at these sites, and will serve as permanent reference points for transect lines. Observations and collections will be made along these lines at specific times during the coming years in conjunction with other work in that area.

Migratory Behavior of the Brown Rockfish Described at Fisheries Meeting

Dr. William H. Lenarz, Task Leader of the Rockfish Analysis Task, participated in the Annual Meeting of the Western Division of the American Fisheries Society at Honolulu, Hawaii, July 13-16, 1981. During the meeting, he chaired a session on Marine and Estuarine Studies and presented a talk, "Movements of rockfish and their implications for stock assessment and management." In his talk, Lenarz noted that in contrast to the results of some other studies of rockfish, results of tagging experiments of brown rockfish indicate significant movement of this species. Therefore the long-term impacts of heavy fishing on local rockfish grounds may not be as serious as previously believed. Lenarz also noted that estimates of vital parameters should take into account movements of rockfish during their life.

FISHERIES DEVELOPMENT INVESTIGATION

Few Euphausiids Caught on Charter Cruise

The Tiburon Laboratory chartered the commercial trawler Sanibel this month to study species composition, availability, and catch rates of euphausiids near Monterey, California. The charter period included 3 nights of fishing from June 30 to July 2, 1981. Cruise Leader Bill Leet reported that only about 400 pounds of euphausiids were caught in eight tows which averaged 2 hours each. Fishery Biologist Sennen Salapare found that E. pacifica was the dominant species, with only a few (5%) of Thysanoessa spinifera mixed in the catch. Incidentally-caught juvenile hake were full of euphausiids, but neither the catch nor echo-sounder recordings indicated the presence of fishable concentrations of euphausiids. Most of the haul contained a fairly large incidental catch of small hake. Some of the euphausiids were packed in 40-pound boxes and frozen, and will be freeze-dried later.

Octopus Fishing Trials to Start Soon

Biological Aid Susan Pollock delivered some octopus traps to a cooperating fisherman in Fort Bragg, California, on July 21, 1981. Traps sent earlier have been soaked in seawater, in preparation for fishing trials slated to start in late August. The target species is Octopus dofleini, the giant Pacific octopus. A number of wooden traps were also sent to a cooperating fisherman in Santa Barbara, California, who intends to fish for other species of octopus. Cooked samples of the giant Pacific octopus, prepared by Japanese methods, were shipped to a potential buyer in Los Angeles, California. Raw specimens were also sent to the firm, which will attempt to market dried octopus in Hawaii.

Details Received on Shortbelly Rockfish Marketing Trials

Sus Kato, Task Leader, reports that three firms which explored numerous ways to market shortbelly rockfish in Japan, have provided details of their efforts to the Fishery Development Investigation. In general, the fish was considered good in terms of taste, texture, and appearance, and could be used in various ways in traditional Japanese cuisine. On the other hand, it was agreed that immediate sale of large groundfish was impossible, and that long-term promotional efforts were needed for its wide-spread use in Japan. Samples provided to the firms were bulk-packed whole fish, in random sizes. The mixed sizes and poor appearance of the samples were common criticisms. Also noted were the fishes' small size, low level of lipids, and low flesh yield. It appears that the care necessary for improving the quality to Japanese standards would increase the cost to the point that it would be uneconomical to market whole shortbelly rockfish in Japan at the present time. One firm has abandoned further attempts, but the other two plan to continue their marketing efforts. One of the firms also sent samples to western Africa and received a generally favorable response. The price offered, however, was apparently difficult to meet.

PHYSIOLOGICAL ECOLOGY INVESTIGATION

Parasite/Pollutant Interaction Studies Continue

Dr. Jeannette A. Whipple, Investigation Leader, reports that the exposure phase of a 6 week experiment testing the effects of pollutants on parasitized and non-parasitized juvenile striped bass has been completed. Sample analyses are also nearing completion and data work-up is presently underway.

Fish were examined for a variety of parameters selected to measure physiological responses to pollutant and parasite stress. Anisakid nematode larvae were injected into the peritoneal cavities of bass which were then exposed to 90 ppb benzene, 40 ppb zinc, and benzene and zinc combined. Preliminary general results indicate parasitized fish suffered more deleterious effects from pollutant exposure than non-parasitized fish. This is based on behavioral responses and systematic macroscopic examination of fish by standardized autopsy procedure developed at Tiburon. Specific effects are being looked into at the whole organism, organ, tissue, cellular, and subcellular levels, using a variety of analytical techniques, some of which are provided in cooperation with researchers at the University of California, Davis and Santa Cruz.

Lipid Composition of Striped Bass Egg Analyzed

Research done on the bioenergetics and food and feeding factors of striped bass embryos and larvae has demonstrated the unique capability of striped bass larvae to withstand prolonged periods of starvation, and to adapt to exogenous feeding at any time until death. This endurance and plasticity is believed to be due in large part to the presence of a large, discrete oil globule which is a prominent part of the striped bass egg at the time of fertilization (see Figure 1).

In cooperation with researchers at the NMFS-Charleston, South Carolina, Laboratory, members of the Physiological Ecology Investigation analyzed in detail the extractable lipid fractions of the yolk and oil globules from eggs of seven sexually mature females. Fish were selected from the Sacramento and San Joaquin Rivers of California, and from the Coos River in Oregon; they ranged in size from 61 to 85 cm standard length and 4.4 to 13.6 kg total wet weights.

In contrast to previous reports in the literature, the oil globule was found to be comprised almost exclusively of wax esters (average 93.4%). The only remaining lipids found in the oil were triacylglycerols. The yolk, which was primarily proteinaceous material, was an average 3.8% lipid, of which the dominant lipid class was phospholipid (78.9%). The remainder was spread out among wax esters, triacylglycerols, free fatty acids and sterols. The fatty acid compositions differed significantly between yolk and oil lipids; this was likely due to differences in the lipid class compositions. Although the fish represented a variety of ages, sizes, locations, physiological conditions, and pollutant burdens, no differences were found in the lipid classes or fatty acids between females.

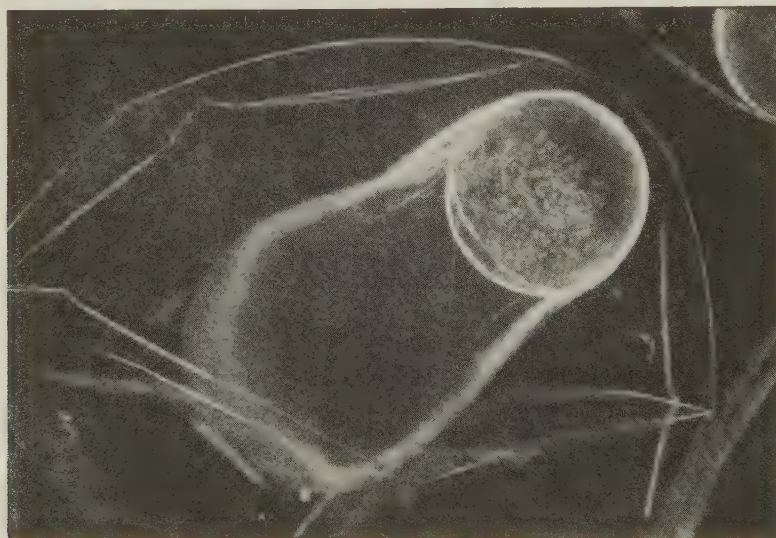


Fig. 1. Fully mature striped bass egg just prior to fertilization. Note spherical oil globule attached to larger yolk mass.

PACIFIC ENVIRONMENTAL GROUP

Satellite Imagery to be Used for Upwelling Process Study

Biological Oceanographer Paul Sund has started a new project in which satellite imagery will be examined for the presence of features in the eastern boundary current region which relate to oceanographic processes under investigation at PEG. Satellite products will be obtained primarily from the NESS Field Station at Redwood City, California. Visible indications of processes such as upwelling, frontogenesis, and front dissipation and decay, transport, and biological productivity will be scrutinized. These features will be studied with respect to the temporal aspects of their formation, movement, and change over time; for geographic locations of high frequency of generation and/or persistence; and for long-term variability in location and behavior. Eventually the timing of generation and of observed changes will be compared to other environmental processes (or indices relating to such) for the possible interpretation of hypotheses concerning ocean-atmosphere inter-relationships and of hypotheses concerning ocean-biological resource inter-relationships.

SOUTHWEST REGIONAL DATA MANAGEMENT AND ADP OPERATIONS

Reports Generated from PACES Data Bases

Fred Kellenberger, Data Systems Manager, reports that the Pacific Area Cooperative Enforcement System (PACES) continues to generate information for the Southwest Fisheries Center, the Southwest Region, and the California Department of Fish and Game. PACES, which contains six data files, was only recently established on the ADP system. Use of PACES allows operators to generate various standards and exception reports from vessel, license, permit, boarding, and sightings data. An additional refinement to PACES is being designed by John Davies, Computer Specialist stationed at the Southwest Region. Davies is setting up an electronic conference system for the enforcement agents of the various agencies that participate in PACES. The agents will be able to circulate information among themselves for the coordination of PACES.

Computer Access Requested for Purse Seine Simulation

Dorothy Roll, Systems Analyst, reports that Jim Coe, Gear Specialist in the Oceanic Fisheries Resources Division, has requested computer access to a government-operated CYBER 203, a Control Data Corporation's (CDC) virtual memory machine. The CYBER 203 is recommended by Beers Associates, Inc. in La Jolla for the completion of the numerical simulation of the purse seine process. Roll has contacted the computer facilities at Langley Research Center, National Aeronautics and Space Administration (NASA) in Hampton, Virginia, concerning available time and memory space on their CYBER 203. John Hogge of Langley Research Center will analyze the requirements to determine whether the LRC can accommodate this request. His reply is expected in mid-August.

North Star System Upgraded

Lt. Mark Sullivan (NOAA Corps), who is assigned to the Data Systems Manager, reports that the North Star Horizon microcomputer system has undergone repair and up-grade, and now has 64K byte memory and two disk drives. Software now includes the North Star disk operating system, BASIC, disk operating system, Pascal, and Meca tape operating system. Operating systems, tape drives, disk drives, terminal, and modem were successfully patched together (at machine level language). This will allow the system to transfer ORION shipboard-created data tapes to dial up complete systems.

Conversion of Financial Reporting System
from INFONET to ADP Continues

Oden Burris, Computer Programmer, and John Davies, Computer Specialist stationed at the Southwest Region, continue the conversion of the Financial Reporting System (FRS) from INFONET to ADP Network Services. Davies, who is responsible for the data entry and data verification programs, is developing programs for the on-line data entries and for batch entries. Burris, who is responsible for the required report programs, is doing a line-by-line code convert, when possible, from INFONET's Program Interface (PI) data base calls to ADP's Host Interface (HI) data base calls. Some logical steps require that the routine be restructured and coded.

UCSD Computer Contract Extended
by Department of Commerce

The Department of Commerce (DOC) has approved an increase and the extension of the University of California, San Diego (UCSD) computer contract through this fiscal year, ending September 30, 1981. The request for FY1982 computer services from UCSD for the La Jolla Laboratory and from the University of Hawaii for the Honolulu Laboratory has been processed by the NMFS' data management office in Washington, D.C. and NOAA's ADP policy office. The request package was submitted to the DOC ADP policy department on July 13. Upon their approval the request will be sent to DOC's procurement division for processing.

ETS/ADP Employee Performance Standards Drafted

Fred Kellenberger, Data Systems Manager, and Dorothy Roll, Systems Analyst, have completed the first draft of the employee performance standards for positions in the Technical Support Group and ADP Operations. Upon review and approval by the designated approving official, the standards will be effective October 1, 1981, as the required basis for performance ratings.

* * * * *

Under a mutual contract agreement with the University of California, San Diego (UCSD), a key entry operator from the Computer Center's Key punch Services will work on-site in the La Jolla Laboratory starting August 10, 1981.

* * * * *

Procedures for obtaining salmon data from the California Department of Fish and Game have been established by Computer Specialist John Davies so that the Southwest Region can release the salmon catch information. This report is a summary of commercial and recreational salmon catch figures for north and south of Pt. Arena, California.

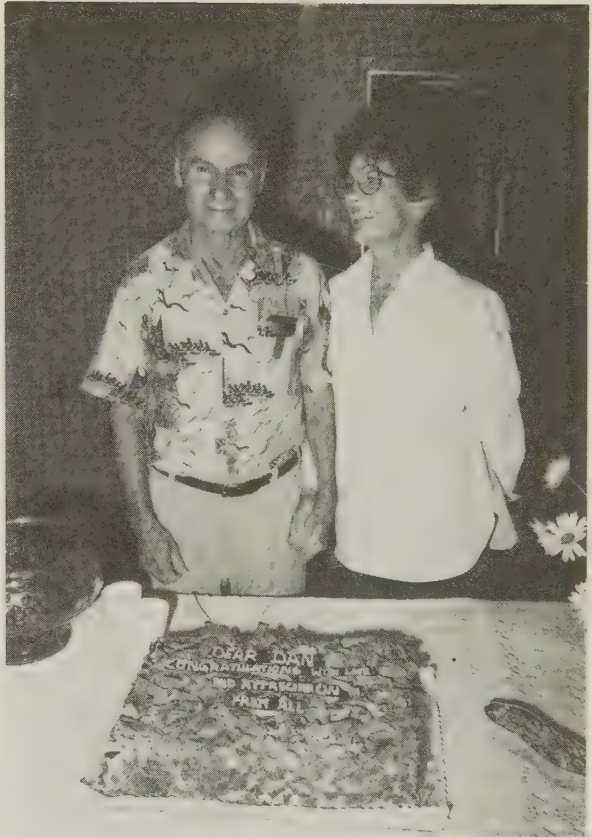
MISCELLANEOUS

HONORS AND AWARDS

Dan Gittings Awarded DOC Bronze Medal

On June 15 Center Director Dr. Izadore Barrett presented Librarian Dan Gittings with a Department of Commerce (DOC) Bronze Medal during a reception held in Gittings' honor at the La Jolla Laboratory. The DOC Medal Awards are given to recognize those people who demonstrate exceptional and sustained effort toward accomplishment of the NMFS mission.

Gittings was honored for selflessly giving "his energies, knowledge, and skills to the organization, development, and maintenance of an outstanding library collection on fish and fisheries at the NMFS Southwest Fisheries Center." Arriving in 1965 at the Center (then called the Bureau of Commercial Fisheries, Fishery-Oceanography Center) in La Jolla, Gittings began to create a library from bare walls, and boxes of loose, uncatalogued books, periodicals, and reprints. Over the years he has built a quality library which is now the only fisheries library in southern California open to outside researchers and the public.



Dan and Ruth Gittings at reception in his honor.

Honolulu Laboratory

On July 15, Center Director Dr. Izadore Barrett presented awards at a general staff meeting to the following Honolulu Laboratory employees: Randolph K. C. Chang, Special Act Award - \$400; James C. Cooper, Sustained Superior Performance - \$300; Andrew E. Dizon, Outstanding Performance-Special Achievement Award; Melvin J. Dutro, Sr., Outstanding Performance-Special Achievement - \$300; William G. Gilmartin, Outstanding Performance-Special

Achievement - \$300; Virginia L. Ishida, Sustained Superior Performance - \$200; Fletcher V. Riggs, Outstanding Performance-Special Achievement - \$400; Mark A. Scheele, Sustained Superior Performance - \$300; Michael P. Seki, Sustained Superior Performance - \$300; Ray F. Sumida, Outstanding Performance-Special Achievement - \$400; Irene H. Toyomura, Outstanding Performance-Special Achievement - \$300; Marian Y.Y. Yong, Outstanding Performance-Special Achievement - \$400; Elizabeth F.Y. Young, Sustained Superior Performance - \$300; Carole A. Yukihiro, Outstanding Performance-Special Achievement - \$300.

La Jolla Laboratory

On July 29 an awards ceremony was held at the La Jolla Laboratory and Dr. Izadore Barrett, Center Director, presented staff members with certificates and cash awards. Recipients who appear in the following photographs include:



Left to right: Frank Ralston, Cash Award; Larry Hansen, Cash Award; William Brinkerhoff, Cash Award; Mark Lowry, Cash Award; Rennie Holt, Quality Step Increase based upon Outstanding Performance Rating; Wayne Perryman, Cash Award.



Left to right: Jacqueline Jennings, Special Achievement (Cash) Award based upon Outstanding Performance Rating; Al Coan, Jr., Cash Award; Norm Bartoo, Cash Award.

Tiburon Laboratory

On July 10, Norm Abramson, Laboratory Director, presented Special Act Cash Awards to Peter Adams and Tina Echeverria.

Stephen Reilly and John Graves Win NOAA Research Fellowships



Dr. Stephen Reilly (left) and Dr. John Graves (right) have been awarded the 1981-1982 National Research Council/National Oceanic and Atmospheric Administration (NOAA) Post-Doctoral Research Fellowships at the Southwest Fisheries Center's La Jolla Laboratory.

Reilly received his Doctorate in Fishery Biology from the University of Washington in June, 1981. He is the first NOAA Fellow ever selected in the Oceanic Fisheries Resources Division at the La Jolla facility. Reilly, a former Biological Technician at the La Jolla Laboratory before resuming his graduate studies, will evaluate data collected on tropical dolphin populations to determine if the methodology of sampling these animals contributes biases in sex, age, geographic distribution, or other factors. His research could provide new insights into dolphin behavior and schooling habits to improve stock assessment.

Graves received his Doctorate in Marine Biology from the University of California at San Diego, Scripps Institution of Oceanography, in June 1981. As a university undergraduate, he worked for several years with researchers at the La Jolla Laboratory, both on research vessels and in the laboratory,

studying the dynamics of fish schools. During his tenure as a NOAA Research Fellow, Graves will investigate the physiological basis of egg production in the northern anchovy, a fish which can spawn every 7-10 days. In conjunction with the work of Dr. John Hunter, Fishery Biologist in the La Jolla Laboratory's Coastal Fisheries Resources Division, Graves hopes to determine how the spawning cycle of the anchovy varies with season. This information will help in the estimation of anchovy spawning biomass.

PUBLIC AFFAIRS

Tiburon Laboratory

On July 16 Dr. Jeannette A. Whipple, Chief of the Physiological Ecology Investigation at the Tiburon Laboratory, was interviewed by a reporter from the California Public Radio concerning striped bass and pollution in San Francisco Bay. The interview and report were aired on public radio on July 31.

PRESS RELEASE

Honolulu Laboratory

July 2 - "NOAA vessel returns from research cruise."

La Jolla Laboratory

July 31 - "Pt. Loma High graduate awarded NOAA Junior Fellowship."

SEMINARS

Honolulu Laboratory

July 10 - Mark J. Rauzon, U.S. Fish and Wildlife Service, spoke on "Natural history of Nihoa Island."

La Jolla Laboratory

July 21 - Mr. Tets Kashima, San Diego High School and the Japanese Citizens League, presented a talk on "A history of the Japanese American exchange in San Diego."

- 22 - Dr. Arthur McEvoy, Northwestern University, Evanston, Illinois, spoke on "The role of science in the history of fishery management."
- 23 - Jerry Kuhn, Scripps Institution of Oceanography, gave a seminar entitled, "Violent storms in the past two centuries: Possible geologic and biologic effects."

TRAINING

Honolulu Laboratory

- July 13-17 - Bernard Ito, Physical Science Technician
- Paul Shiota, Biological Technician
- James Uchiyama, Supervisory Fishery Biologist - all completed "Introduction to Supervision" training course.

La Jolla Laboratory

- June 15- - J. Michael Gregory, Biological Technician - "Cobol
July 22 Programming," La Jolla, California.
- June 29- - Fred Kellenberger, Data Systems Manager - "Network
July 1 Protocol," Los Angeles, California.
- June 30- - Lorraine Zorich, Administrative Assistant - "Reduction-
July 2 in-Force Workshop," Los Angeles, California.

Tiburon Laboratory

- July 22-23 - Sharon Lundin, NASO, presented training on the new Workforce Performance Appraisal System. Supervisors attended the July 22 session, and the remainder of the staff received instruction on July 23.

VISITORS

Honolulu Laboratory

- July 2 - Dr. E. H. Chave, Interim Director, Hawaii Undersea Research Laboratory.

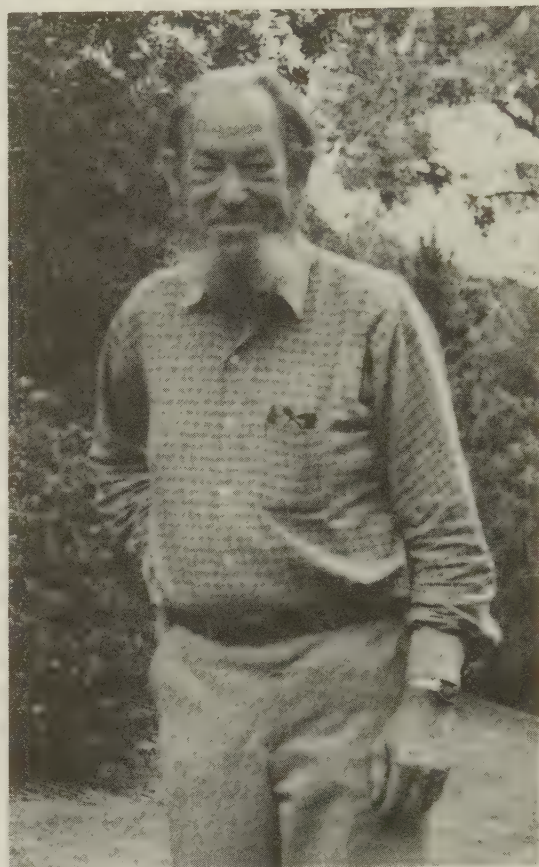
- 9 - James T. Movick, Deputy Chief for South Pacific Affairs, Department of External Affairs, Federated State of Micronesia.
- 13 - Robert E.K.D. Lee, Food and Agriculture Organization, United Nations Development Project, Phuket, Thailand.
- 13-14 - Center Director Dr. Izadore Barrett, Deputy Director John Carr, and Planning Officer Dave Mackett conducted Honolulu Laboratory task reviews.
- 15 - Mel Odemar, California Fish and Game, Sacramento, California.
- 17 - Dr. William F. Royce, Seattle, Washington.
 - Joseph Greenough, Inter-American Tropical Tuna Commission (IATTC), La Jolla, California.
 - Dr. Robert Kearney, South Pacific Commission (SPC), Noume, New Caledonia.
 - Mike A. McCoy, Micronesian Maritime Authority, Ponape, Eastern Caroline Islands.
- 20 - Salah E. Zaalouk, First Undersecretary for Aquatic Resources, Ministry of Agriculture, and Yehia Moh Hassan, Special Assistant to the First Undersecretary, Ministry of Agriculture, Dokki, Egypt.
 - Dr. Khairy E. Aref and Raymond M. Hertel, KNBS Consulting and Civil Engineers, Los Angeles, California.
- 21 - Senator Hank Takawo, Palau Legislature, Koror, Western Caroline Islands, Palau.

La Jolla Laboratory

- July 1 - Eric A. Kwei, Starkist International, Tema, Ghana.
- 6 - Steve Yates, Texas A & M University, College Station, Texas.
 - LCDR Robert C. Roush, New Executive Officer of NOAA Ship Townsend Cromwell, Honolulu, Hawaii.
- 6-7 - David Hamm, Honolulu Laboratory, SWFC, NMFS.

- 7 - Sogui Diouff (Senegal), Vicente Andrade Gomes (Cabo Verde), and Mahmoud Abdelhedi (Tunisie), all from Crossroads Africa, New York, New York.

July 7 through 9, Dr. Erik Bertelsen, former head of the Danish Fisheries Department, visited the La Jolla Laboratory and discussed his work on angler fish larvae with Fishery Biologist Dr. Geoff Moser. Dr. Bertelsen is currently Ichthyologist at the Zoological Museum, University of Copenhagen, Copenhagen, Denmark.



- 10 - Edwel H. Santos, Speaker of the Ponape State Legislature, Kolonia, Ponape, East Caroline Islands.
- 13 - Peter J. Wright, member of the New Zealand Government committee on sportfishing, met with Fishery Biologist Jim Squire at the La Jolla Laboratory.
- 15 - Mr. Dah-wen Shieh, Assistant Specialist, Council for Agricultural Planning and Development, Taiwan.
- H.I.S. Bagoua, Kunduchi Fisheries Institute, Dar-es-Salaam, Tanzania.
- Daniel N. Quaynor, Research and Utilization Branch, Tema, Ghana.
- Kevin McCann, Operations Crossroads Africa, New York, NY.

- 22 - His Excellency Atanraoi Baiteke, Secretary for Foreign Affairs and Roving Ambassador for Kiribati, Bairiki, Tarawa, Republic of Kiribati, and Yoshitsugu Nishimoto, Deputy Secretary General of the Japanese Socialist Party, Hokkaido, Japan, visited the La Jolla Laboratory.



Left to right: Mr. Hibi (interpreter), Mr. Nishimoto, His Excellency Mr. Baiteke, and Sator Blackiston (U.S. State Department).

- 24 - Dr. Dan Kimura, State of Washington Department of Fisheries, visited the La Jolla Laboratory and met with Dr. Gary Sakagawa, Chief of the Oceanic Fisheries Resources Division.

Tiburon Laboratory

- July 8 - Gunter R. Seckel and Paul N. Sund, Pacific Environmental Group, NMFS, Monterey, California.
- 15 - Jim Poulos, R-Ranch, Ltd., Emeryville, California.

- 20 - Chris Dewees, Sea Grant Marine Advisory Program,
University of California, Davis.
- 21 - Cheng-Chung Hong, and William C.C. Hong, Taiwan Water
Pollution Control Agency, Taipei Shien, Taiwan.
 - Zeke Grader, Pacific Coast Federation of Fishermen,
Sausalito, California.
- 22 - Sharon Lundin, NASO, Seattle, Washington.
- 30 - Steve Taylor, California Department of Fish and Game,
Rancho Cordova, California.

MEETINGS AND TRAVEL

Honolulu Laboratory

- July 13-16 - Dr. Michael Adams, James Cooper, Dr. Andrew Dizon,
Dr. Jeffrey Polovina, J. Riggs, Laboratory Director
Richard Shomura, Richard Uchida, Dr. Jerry Wetherall,
and Howard Yoshida attended the joint annual conference
of the Western Association of Fish and Wildlife Agencies
and Western Division, American Fisheries Society, at the
Ala Moana Hotel, Honolulu.
- 22 - Richard Shomura attended the Hawaii Fisheries
Coordinating Council meeting at the Hawaii Department
of Land and Natural Resources board room.
 - 23 - Richard Shomura participated in the Western Pacific
Regional Fishery Management Council's (WPRFMC)
comprehensive data project and programmatic planning
session in the Honolulu Laboratory conference room.
- 28-30 - Richard Shomura traveled to Kailua-Kona, Hawaii to
participate in the WPRFMC/SSC meetings.

La Jolla Laboratory

- June 16- July 14 - Dr. William Perrin traveled to Cambridge, England, to
convene an International Whaling Commission workshop on
the identity and structure of killer whale populations,
and to chair the 1981 meeting of the IWC standing sub-
committee on small cetaceans. He then traveled to Paris,
France, to examine specimens in the National Museum of
Natural History.

- June 21- - Dr. John Hunter traveled to Lima, Peru, to assist in
July 18 development of a fishery research program.
- July 1-2 - Robert Nishimoto traveled to Eureka, California to
 instruct fishermen on tagging albacore and the
 collection of biological and oceanographic data.
- 6 - Dr. Izadore Barrett, Dr. Daniel Huppert, Dr. Reuben
 Lasker, Alec MacCall, Jane McMillan, Dr. Gary Stauffer
 and Rich Charter traveled to Long Beach, California
 to attend a joint meeting of the Pacific Fishery
 Management Council and the California Fish and Game
 Commission to review the 1981 anchovy biomass
 estimate.
- 6-10 - Jim Squire traveled to the Cabo San Lucas area of
 Baja California, Mexico, to distribute gamefish
 tagging equipment and to make the annual Gardiner
 Foundation Tagging Awards.
- 7 - A Budget and Administration and ADP Task Review
 meeting was held at the La Jolla Laboratory.
- 8-9 - Dr. Gary Stauffer attended a Pacific Fishery Management
 Council meeting on the quota for the 1981/82 season, held
 in Boise, Idaho.
- Dr. Izadore Barrett, John Carr, and Dave Mackett traveled
 to Tiburon, California to participate in Task Reviews of
 the Tiburon Laboratory and Pacific Environmental Group
 (PEG).
- 10 - A CalCOFI meeting was held at the La Jolla Laboratory.
- 10-13 - Dr. Doug DeMaster conducted assessment studies of Zalophus
 pups on San Nicholas Island off the California coast.
- 13 - Dr. Geoff Moser traveled to Los Angeles, California to
 examine specimens of fish larvae and consult with
 Robert Lambert, Head of the Ichthyology Department
 of the Los Angeles County Museum of Natural History.
- 13-17 - Dr. Izadore Barrett, Center Director, traveled to Honolulu,
 Hawaii to attend a meeting of the Western Division of the
 American Fisheries Society and to review the Honolulu
 Laboratory program.
- John Carr, Deputy Director, and Dave Mackett, Planning
 Officer, traveled to Honolulu, Hawaii to attend the
 Honolulu Laboratory Program review.

- 14-16 - Dr. Daniel Huppert participated in a Source Evaluation Board for contract on multi-species limited access study, held in Seattle, Washington.
- 20 - A meeting was held at the La Jolla Laboratory among members of the SWFC staff, California Department of Fish and Game, and American and Mexican fish processors.
- 27-29 - A meeting concerning U.S-Mexico tuna negotiations was held at the La Jolla Laboratory.
 - Ben Remington, Executive Officer, traveled to Portland, Oregon to attend FTE training and to Seattle, Washington to discuss administrative matters with NASO personnel.

Tiburon Laboratory

- July 13-16 - Dr. William H. Lenarz participated in the Annual Meeting of the Western Division of the American Fisheries Society at Honolulu, Hawaii. During the meeting, he chaired a session on Marine and Estuarine Studies and presented a talk, "Movements of rockfish and their implications for stock assessment and management."
- 14-18 - Sus Kato traveled to Avila Beach, Santa Barbara, and Los Angeles, California, to confer with industry members on input for research plans, and to provide samples of under-utilized fishes to potential users.

PERSONNEL

Honolulu Laboratory

- July 4 - Heeny S.H. Yuen, Fishery Biologist - Voluntary Retirement.
- 11 - George W. Liao, Operations Research Analyst - Separation/Transfer.
- 12 - Martina K.K. Queeneth, Biological Technician (Fisheries) - Promotion.
- 26 - Randolph K.C. Chang, Fishery Biologist - Promotion.
 - Fletcher V. Riggs, Fishery Biologist - Promotion.
- 27 - Louise F. Lembeck, Editorial Clerk (Typing) - Temporary Appointment.

- 31 - Gerald O. Palermo, Jr., Biological Aid (Fisheries) - Termination.

La Jolla Laboratory

- June 19 - Susan D'Vincent, Biological Technician - Leave Without Pay, NTE 11-2-81.
- July 5 - Hillary Herring-Dyal, Fishery Biologist - Transfer.
- Martin Johnson, NOAA Junior Fellow - Return to Duty.
- 6 - Kathy McKune, Clerk Typist - Temporary Appointment.
- 11 - Robert Nydam, Computer Programmer - Resignation.
- Joseph Caruso, Computer Specialist - Resignation.
- 12 - Richard Kiy, NOAA Junior Fellow - Promotion.
- 16 - Sheila Foster, Editorial Assistant - Resignation.
- 26 - Rennie Holt, Operations Research Analyst - Promotion.
- Norman Bartoo, Fishery Biologist - Promotion.
- 27 - Betty Andrews, Clerk Typist - Temporary Appointment.

Tiburon Laboratory

- July 29 - Sonia A. Linnik, Biological Aid - Termination of Temporary Appointment.

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DEPARTMENT OF COMMERCE

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